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CLASS II

This Report is Informal and the Conclusions are only Tentative

SUFFIELD FIELD REPORT NO. 88
(23 Aug 1944)

Casualty Producing Power of Unthickened Mustard Gas Sprayed from Low Altitudes under Temperate Weather Conditions

REFERENCE

Field Experiment No. 229 carried out 25 May 1944.
Field Experiment No. 243 carried out 15 June 1944.
U.S. Project Co-ordination Board Meeting held at Edgewood 27 April 1944.
D.C.W. & S. Project S.143.
Suffield Field Report No. 76.

INTRODUCTION

1. This report deals with the results of Field Experiment No. 243, the second field trial carried out to evaluate the casualty producing power of low spray with unthickened mustard gas. It was found from the first trial, Field Experiment No. 229 reported in Suffield Field Report No, 76, that a high percentage of casualties would occur among men who were exposed to contamination densities of 3 g/sq.m. and above, the densities being measured by the contamination occuring on the ground. The drop sizes of the contamination ranged from 0.005 mg to 0.05 mg. in mass, or 0.2 to 0.4 mm. in diameter, approximately. The wind speed was 12.5 mi/hr. at 2 metres. The men were respirators at the gas position, non-impregnated battledress, long limbed underwear, anklets, socks, and boots. Over the battledress, impermeable clothing with two 4" x 4" windows cut over the shoulders, buttocks, and calves, was worn. The contaminated clothing was worn for 4 hours. The determination of whether or not a man became a casualty was based on the effects which it was expected would have occurred if no impermeable clothing had been worn.

2. Field Experiment No. 243 was designed to assess the casualty producing power of unthickened HS(Lovinstein) in the contamination range below 1.5 g/m^2 with drop sizes below 0.02 mg. drop weight (0.3 mm. diameter).

MATERIAL

3. (a) One M10 Tank charged 326 lbs. HS(Lovinstein) dyed 0.5% Dupont Oil Red.

(b) The tank was fitted with a No. 2 detonator at the air inlet and a No. 3 detonator at the discharge outlet.

(c) The viscosity (Ostwald) of the charging at 25°C was 5.6 centipoises before dyeing and 15 centipoises after dyeing.

(d) The specific gravity of the charging was 1.34.

(e) The temperature of the charging at take-off was 17°C.

PROCEDURE

Observers

4. Twenty-eight observers were disposed in lines of seven each, 100 yards, 120 yards, 140 yards and 160 yards downwind of the upwind edge of the layout as indicated in Appendix I. The observers were 100 yards apart in each line.

5. During the spraying, the observers stood facing downwind. They were dressed as follows:-

Battle-dress, non-impregnated.
Shirts, long sleeved, cotton.
Anklets, socks and boots.
Respirators at the gas position.
Impermeable clothing (coat and trousers) was worn over the battle-dress, impermeable hoods were worn over the head, and rubber gloves on the hands.
No underwear was worn by the observers.

6. Windows 4" x 4" were cut in the impermeable clothing in the following positions:-

(i) One window at the back of each shoulder.

(ii) One window in the centre of the back, just above the belt, on the loosely fitting part of the battle-dress blouse. The edges of the windows were sewn down to the battle-dress.

7. A filter paper assembly (with circular filter paper surface 8 inches in diam.) was fastened to the back of each observers just below the waist line.

8. After the spray had fallen the observers moved off the contaminated area and the impermeable clothing was removed. The remainder of the clothing was worn for four hours after the spraying. During this time fourteen of the men took part in outdoor Station fatiques (digging trenches, raking, etc.). The remaining fourteen men lay or sat about in a room at 75°F.

Assessment of Ground Contamination

9. Eleven rows of filter paper assemblies, 100 yards between rows, were laid out parallel to the wind direction. Each row was 160 yards long and consisted of filter paper assemblies at 20 yard intervals. At each observer position three additional assemblies and 4 jump cards were placed in proximity to the observer as shown in Appendix I. Assessment of ground contamination was carried out by colorimetric estimation of the dye caught on the filter papers. The jump cards were not assessed.

10. Samples of the sprayed mustard gas were collected in chloroform in pie plates one of which was placed at each observer position. The amount of dye in each plate was determined colorimetrically. The amount of mustard gas on each plate was estimated by the bromine titration method. A sample of mustard gas from the spray tank was similarly analysed for dye and mustard content.

Functioning of the M10 Tank

11. The M10 Tank was functioned from the starboard wind stowage of a Boston IV (A203) aircraft.

12. The A/C flew at a height of 35 feet (measured by theodolites) at a true airspeed of 215 mi/hr. The track was indicated by a line of markers and was such that the upwind edge of contamination fell just upwind of the edge of the layout.

RESULTS

Meteorological Conditions

13. Time: 1136 MDT.
Wind Velocity at 2 metres at time of spraying: 15 mi/hr.
Air Temperature: 16°C (61.5°F).
Ground Temperature: 21°C (70°F).
Relative Humidity: 67%.
Temperature Gradient: 39 ft - 4 ft: -1.8°C.

Contamination Densities

14. The contamination densities found on the layout and on the filter paper assemblies fastened to the backs of observers are given in Appendix II. Total recovery on the layout was 93% of original charging. The maximum ground contamination found at observer positions was 1.23 g/sq.m. Maximum contamination density on observers backs was 7.3 g/sq.m. The maximum ground contamination found on the layout was 8.8 g/sq.m.

15. The results of chemical and colorimetric analysis of the spray as caught on the chloroform filled plates have been rendered useless on account of an untrustworthy sample of charging used as a standard for the calibration. (The charging had not been filtered before use.)

Effects on Observers

16. Of the 28 observers exposed to the spray only two developed vesication of the skin, the vesication was on the shoulders corresponding to the site of the windows in the impermeable clothing they wore. No vesication was noted on the region of the window on the lower back. It was considered that these men would have become casualties had they not worn impermeable clothing.

17. Besides the two mentioned above, five observers showed areas of erythema and oedema (E+). Three of these men had been on previous trials where they had been burned by H under hot humid conditions. An additional two men of which one had been previously burned by H vapour under hot humid conditions showed sharp erythema(E); five men showed faint erythema (E-). Of these latter five, one had previously been burned by H vapour under hot humid conditions.

18. A summary of the physiological effects on observers together with the contamination densities found on observers and on the ground at observer positions is given in Table I below. Descriptions of the lesions obtained on this trial are given in Appendix III.

Classification / Designation
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By Authority of
Sur l'Autorité de C. Laforce
Date 2 Feb 98 Signature D. Kuseler
Appointment
Fonction Unit

TABLE I

Observer Position	Ground Contamination Density g/sq.m.	Vertical Contamination Density (Observer's backs) g/sq.m.	Dominant Drop Size found on Observers		Physiological Effect	Casualties*
			mg	mm		
D6	1.23	7.3	.015	0.28	V, E +	Yes.
D9	0.97	4.9	.035	.37	S E	No
D8	0.95	-	.025	.33	S E +	possible (Yes)
D7	0.90	2.5	.050	.41	E +	No
F9	0.81	2.2	.005	.19	S E +	No
E7	0.74	6.4	.025	.33	V, E +	Yes
E8	0.68	2.9	.025	.33	S E +	(No)
F6	0.56	1.94	.020	.30	E +	No
E6	0.51	0.85	.025	.33	E -	No
F7	0.42	0.98	.020	.30	E	No
F8	0.29	0.28	.015	.28	Nil	No
C6	0.18	0.43	.025	.33	Nil	No
G6	0.18	0.26	.025	.33	Nil	No
C7	0.11	0.13	.015	.28	Nil	No
G7	0.11	0.47	.010	.24	Nil	No
H7	0.11	1.18	.010	.24	E -	No
C8	0.10	0.18	.020	.30	Nil	No
A6	0.07	0.28	.005	.19	Nil	No
E9	0.07	0.10	.005	.19	E -	No
C9	0.07	0.19	.010	.24	Nil	No
G8	0.05	0.30	.020	.30	Nil	No
H9	0.05	0.09	.015	.28	Nil	No
G9	0.04	0.10	.005	.19	S E -	No
J6	0.04	0.08	.010	.24	Nil	No
H8	0.03	0.09	.015	.28	E -	No
J7	0.03	0.09	.010	.24	Nil	No
J8	0.02	0.11	.015	.28	Nil	No
J9	0.03	0.08	.015	.28	Nil	No

*In the above table the classification of casualty or non-casualty is based on the effects which would be expected if impermeable clothing had not been worn.

S These men had been previously burned by H vapour under hot humid conditions.

19. Due to the low height at which the A/C flew, the heaviest contamination was deposited well upwind of the observers with the result that the ground contamination densities obtained at observer positions were lighter than were expected. The number of observers showing even mild lesions was therefore small.

20. The results given in Table I indicate that observers dressed as for this trial but without impermeable clothing exposed to low spray with unthickened Levinstein mustard in regions where the ground contamination density is much less than 1 g/m^2 are unlikely to become casualties. However, the number of observers exposed to ground contaminations of about $1g/m^2$ is too small to enable a firm conclusion to be drawn from the results of this trial.

21. The fact that five of the observers had been previously exposed to mustard vapor under hot humid conditions, and showed possible sensitivity to mustard vapor, (they all developed a morbilliform type of rash after exposure) does not detract from the value of the results. Four of them were exposed at positions where the ground contamination was between 0.68 and 1.0 g/sq.m. It was considered that two of them would not have been casualties had they not worn impermeable clothing, one of them probably would not have been a casualty, and one of them probably would have been a casualty. This strengthens the conclusion that ground contamination densities less than 1 g/sq.m. are unlikely to produce casualties among observers dressed as for this trial but without impermeable clothing.

22. The vertical contamination densities obtained on the backs of observers may be compared with those which would be expected, knowing the ground contamination density, windspeed, and size of droplets involved. The results of such a comparison are given in Table II below.

TABLE II

Observer	Vertical Contamination Density		
	Calculated	Observed	Ratio $\frac{\text{Calculated}}{\text{Observed}}$
D6	5.7	7.3	0.78
D9	3.4	4.9	0.69
D8	3.9	-	-
D7	2.9	2.5	1.16
F9	5.2	2.2	2.36
E7	3.0	6.4	0.47
E8	2.7	2.9	0.93
F6	2.4	1.94	1.24
E6	2.0	0.85	2.35
F7	1.8	0.98	1.84
F8	1.3	0.28	4.65
C6	.71	0.43	1.65
G6	.71	0.26	2.74
C7	.50	0.13	3.85
G7	.59	0.47	1.25
H7	.59	1.18	0.50
C8	.43	0.18	2.40
H6	.44	0.28	1.57
E9	.44	0.10	4.40
C9	.38	0.19	2.00
G8	.22	0.30	0.73
H9	.23	0.09	2.56
G9	.26	0.10	2.60
J6	.21	0.076	2.76
H8	.14	0.090	1.55
J7	.17	0.090	1.89
J8	.09	0.110	0.82
J9	.14	0.08	1.75
		Mean	1.91

23. The mean ratio of calculated to observed vertical contamination density is 1.9. The vertical contamination density was calculated from the horizontal density assuming that the surface of a man's back is an ideal collector and that the wind direction was normal to the man's back. In actual practice this will not be the case, so that it is to be expected that the ratio would be greater than unity.

24. The wide variation of the ratio from man to man probably reflects the deviation of the measured ground contamination from that which corresponded to the contamination measured on the observer's back, i.e., on account of the patchiness of contamination and the low angle of descent of the drops, the ground contamination at an observer's feet would not be the same as the ground contamination which would normally be produced by the droplets striking the observer.

25. As mentioned above, vertical contamination density obtained on an observer's back depends upon both wind speed and direction, and also upon the ground contamination in the vicinity of the observer. For these reasons, and also on account of the patchiness of contamination produced by low spray with unthickened mustard from an M10 Tank, it will not be possible to make a firm statement about the casualty producing power of such low spray until a fairly large number of observers have been contaminated in a range of wind speeds.

CONCLUSIONS

26. Casualties among troops sprayed with unthickened Levinstein HS in a 15 mi/hr. wind and wearing respirators, unimpregnated battle-dress, and cotton shirts will be infrequent if the ground contamination density is less than 1 g/sq.m. Depending upon the windspeed and drop size, for wind speeds above 3 mi/hr. this density corresponds to a considerably higher contamination density on a vertical surface.

AWB:rea

A.W. Birnie

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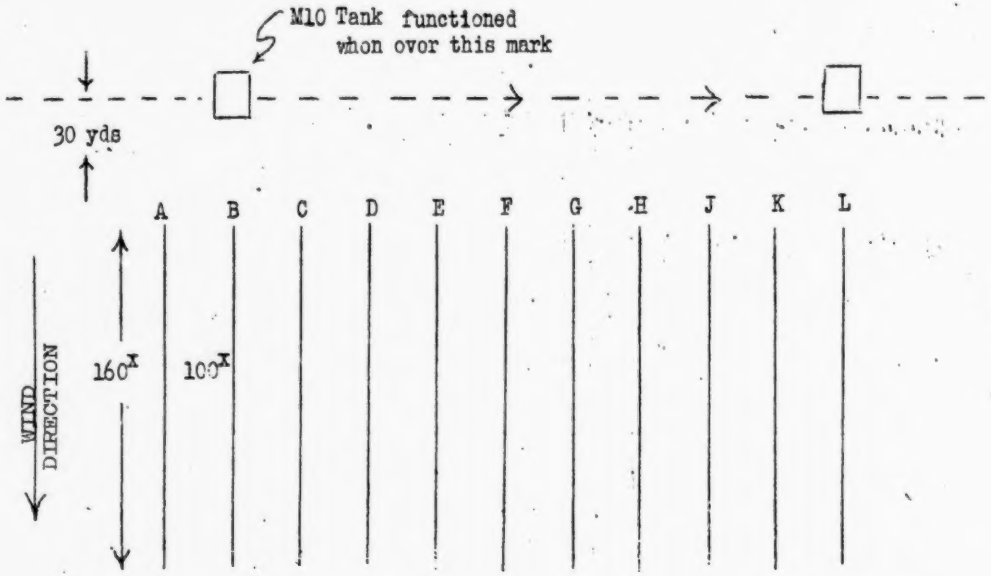
APPENDIX I

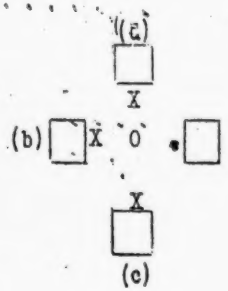


Tracking marks (white jump cards in form of inverted V 4 ft high) opposite rows B and L.

→ Additional tracking marks - white jump cards - opposite rows F and J.

11 rows of filter paper assemblies 100 yards apart each row consisting of filter papers 20 yards apart (9 papers).

Observers were positioned on lines C, D, E, F, G, H, and J, 100, 120, 140 and 160 yards downwind from the upwind edge of the layout. (28 observers) Near each observer were additional jump cards and filter papers as shown below.



• Layout filter papers.

Large jump cards touching outer edge of filter papers.

X Additional filter papers $2\frac{1}{2}$ yards from observer.

O Observer, $2\frac{1}{2}$ yards from layout filter papers.

APPENDIX II

The contamination densities found on the layout and on the backs of observers, together with dominant drop size at each point are given in Table I. The individual densities found on the four papers at observer positions are given in Table II.

Table I

Position	Contamination (g/sq.m.) Layout (mean)	Back of Observer	Dominant Drop size (mg) Layout	Observer
B 1	0.02			
2	0.07			
3	0.21			
4	0.09			
5	0.04			
6	0.02			
7	0.08			
8	0.22			
9	0.34			
C 1	2.0			
2	4.0			
3	1.08			
4	0.46			
5	0.61			
6	0.18	0.43	.005	.025
7	0.11	0.13	.015	.015
8	0.10	0.18	.015	.020
9	0.07	0.19	.010	.010
D 1	1.05			
2	8.8			
3	7.7			
4	5.8			
5	3.2			
6	1.23	7.3	-	.015
7	0.90	2.5	-	.050
8	0.95	-	-	.025
9	0.97	4.9	.025	.035
E 1	8.3			
2	4.2			
3	1.72			
4	2.0			
J 1	0.10			
2	0.08			
3	0.01			
4	0.02			
5	0.01			
6	0.04	0.076	.010	.010
7	0.03	0.090	.010	.010
8	0.02	0.11	.010	.015
9	0.03	0.08	.015	.015
K 1	0.01			
2	0.04			
3	0.03			
4	0.05			
5	0.03			
6	0.02			
7	0.05			
8	0.02			
9	0.03			

Position	Contamination (g/sq.m.) Layout (mean)	Back of Observer	Dominant Drop size (mg) Layout	Observer
E 5	2.5			
6	0.51	0.85	025	.015
7	0.74	6.4	-	.025
8	0.68	2.9	.020	.025
9	0.07	0.10	.020	.005
F 1	0.90			
2	2.6			
3	5.7			
4	4.0			
5	1.06			
6	0.56	1.94	-	.020
7	0.42	0.98	-	.020
8	0.29	0.28	.010	.015
9	0.81	2.2	-	.005
G 1	0.40			
2	0.91			
3	0.28			
4	0.66			
5	0.16			
6	0.18	0.26	.015	.025
7	0.11	0.47	-	.010
8	0.05	0.30	.015	.020
9	0.04	0.10	.010	.005
H 1	0.03			
2	0.34			
3	0.10			
4	0.14			
5	0.08			
6	0.07	0.28	.005	.005
7	0.11	1.18	.005	.010
8	0.03	0.09	.010	.015
9	0.05	0.09	.010	.020
L 1	<0.01			
2	0.01			
3	0.06			
4	0.01			
5	0.02			
6	0.01			
7	0.01			
8	0.01			
9	<0.01			

APPENDIX II (CONT.)

Table II

Position	Contamination Density in grams per square metre				
	Layout paper observers left	(b) observers right	(c) downwind (front)	(d) upwind (rear)	Mean
C 6	0.41	0.12	0.04	0.16	0.18
7	0.27	0.08	0.02	0.06	0.11
8	0.10	0.08	0.04	0.19	0.10
9	0.08	0.12	0.03	0.05	0.07
D 6	1.12	0.93	0.88	2.01	1.23
7	0.58	1.59	0.52	0.92	0.90
8	0.97	1.09	0.85	0.89	0.95
9	1.74	0.21	0.83	1.11	0.97
E 6	1.04	0.52	0.18	0.40	0.51
7	0.86	0.67	0.58	0.85	0.74
8	0.53	1.45	0.12	0.64	0.68
9	0.05	0.08	0.05	0.08	0.07
F 6	0.40	0.97	0.50	0.35	0.56
7	0.85	0.16	0.41	0.25	0.42
8	0.21	0.24	0.08	0.61	0.29
9	0.60	0.77	0.60	1.25	0.81
G 6	0.37	0.12	0.14	0.10	0.18
7	0.11	0.08	0.18	0.06	0.11
8	0.04	0.04	0.05	0.06	0.05
9	0.06	0.04	0.04	0.02	0.04
H 6	0.15	0.04	0.05	0.05	0.07
7	0.04	0.04	0.25	0.12	0.11
8	0.04	0.02	0.02	0.03	0.03
9	0.04	0.05	0.06	0.06	0.05
J 6	0.05	0.02	0.03	0.05	0.04
7	0.05	0.03	0.02	0.04	0.03
8	0.02	0.01	0.01	0.04	0.02
9	0.05	0.01	0.02	0.02	0.03

APPENDIX III

Casualty Producing Power of Unthickened Mustard Sprayed from Low Altitudes under Temperate Conditions

Note. It should be remembered that during the spray the observers wore impermeable clothes. A window, 4" x 4" was cut out of the impermeable clothing over each shoulder and the middle of the back. The impermeable clothing was sewn to the battle dress at the edges of the windows to prevent mustard flowing down between the two layers of cloth.

Casualties and non-casualties are based on the effects to be expected if impermeable clothes had not been worn.

Observer C 8 Contamination on observer 0.43 gms/m^2. Predominant drop size .025 mg. Contamination on ground 0.18 gms/m^2. No effects. Non-casualty.

Observer C 7 Contamination on observer 0.13 gms/m^2. Predominant drop size .015 mg. Contamination on the ground 0.11 gms/m^2. No effects. Non-casualty.

Observer C 8 Contamination on observer 0.18 gms/m^2 Predominant drop size .020 mg. Contamination on ground 0.10 gms/m^2. No effects. Non-casualty.

Observer C 9 Contamination on observer 0.19 gms/sq m. Predominant drop size .010 mg. Contamination on ground 0.07 gms/m^2. No effects. Non-casualty.

Observer D 6 Contamination on observer 7.3 gms/m^2. Predominant drop size .015 mg. Contamination on ground 1.23 gms/m^2. Twenty-four hours after the spray, both shoulders showed vesicated areas surrounded by pin point vesication. The entire back was involved in erythema from the neck to the belt line. Casualty.

Observer D 7 Contamination on observer 2.5 g/ sq m. Predominant drop size 0.050 mg. Contamination on ground 0.90 g/sq m. By 24 hours this man had developed wide spread erythema of the back with no oedema. This remained up to 72 hours and then started to fade. Non-casualty.

Observer D 8 Contamination on the ground in this region was 0.95 gms/m^2. The card from the back of the observer was lost. The predominant drop size was .025 mg. At 24 hours this observer showed erythema and oedema at the site of the windows on his shoulders and a morbilliform rash involving the back and extending down over the buttocks. The rash was also apparent at the bends of the elbows and in the groin. At 72 hours the rash had appeared in both armpits and an area was desquamating on each shoulder.

This man had previously sustained a burn around his neck from H vapour under hot humid conditions. Under the conditions of this trial he might possibly have been a casualty, but whether from the spray or combined actions of sensitivity and spray it is hard to say.

Possible Casualty.

Observer D 9 Contamination on the observer was 4.9 gms/m^2. Ground contamination was 0.97 gms/m^2. The predominant drop size was .035 mg. This man at 24 hours showed extensive erythema on his shoulders which had progressed by 48 hours and showed a morbilliform type ofrash. This man had also been exposed on a previous trial to mustard vapour under hot humid conditions. Non-Casualty.

E 6 Contamination on the observer was 0.85 gms/m^2; ground contamination was 0.51 gms/m^2; the predominant drop size was .015 mg. At 24 hours he showed a small area of faint erythema on his left shouldor which had started to fade at 48 hours. Non-Casualty.

E 7 Contamination on this observer was 6.4 gms/m^2. Ground contamination was 0.74 gms/m^2. The predominant drop size was .025 mg.

At 24 hours this man showed small annular vesicles on both shoulders surrounded by areas of erythema and oedema. There was some erythema in the small of the back in the region of the third window.

At 48 hours the vesication had progressed and the areas of erythema and oedema had become larger. Casualty.

E 8 Contamination on this observer was 2.9 gms/m^2 by drops .025 mg. in size. Ground contaminati n was 0.68 gms/m^2.

At 24 hours he showed areas of erythema and oedema in the region of the windows on his shoulders. These two areas were surrounded by a morbilliform type of rash. This man had been previously burned by H vapour under hot humid weather conditions.

It is doubtful if this man would have become a casualty under the conditions of this trial.

Non-Casualty

Observer

E 9 Contamination on this observer was 0.10 gms/m^2 by droplets of .005 mg. size. Ground contamination was 0.07 gms/m^2. At 24 hours he showed a faint area of erythema on his left shoulder which faded by 48 hours.

Non-Casualty

F 6 Contamination on this observer was 1.94 gms/m^2 by drops of .020 mg. Ground contamination was 0.56 gms/m^2. At 24 hours he showed erythema and oedema of skin over the shoulders and faint erythema of the mid-line of the back. This area progressed in erythema to 48 hours but never desquamated.

Non-Casualty

F 7 Contamination on this observer was 0.98 gms/m^2 by droplets of .020 mg. Ground contamination was 0.42 gms/m^2. At 24 hours he showed a diffuse area of erythema over the upper back. At 48 hours these areas had become better defined and more localized to the areas underneath the windows.

Non-Casualty

F 8 Contamination on this observer was 0.28 g/sq. m. The predominant drop size was .015 mg. Ground contamination was 0.29 g/sq. m. No effects.

Non-Casualty

F 9 The contamination on this observer was 2.2 gms/m^2 by drops of .005 mg. size. Ground contamination was 0.81 gms/m^2. At 24 hours there were areas of erythema and oedema present on the shoulders. By 48 hours a morbilliform rash had developed which extended from the neck to the buttocks. This man had been previously burned by H vapor under hot, humid conditions. Under the conditions of this trial it is unlikely that he would have become a casualty.

Non-Casualty

G 6 The contamination on this observer was 0.26 g/sq. m. The predominant drop size was .025 mg. Ground contamination was 0.18 g/sq. m. No lesions developed.

Non-Casualty

G 7 The contamination on the observer was 0.47 gms/m^2 by drops of .07 mg. size. Ground contamination was 0.11 gms/m^2. No lesions developed.

Non-Casualty

G 8 The contamination on the observer was 0.30 gms/m^2 by drops of .020 mg. size. Ground contamination was 0.05 gms/m^2. No lesions developed.

Non-Casualty

G 9 The contamination on this observer was 0.10 gms/m^2 by drops of .005 mg. size. Ground contamination was 0.04 gms/m^2. At 24 hours a morbilliform rash had appeared in the mid-line of the back, extending from the neck to the natal cleft. This man had previously been exposed to H vapor under hot humid conditions.

Non-Casualty

H 6 The contamination on the observer was 0.28 gms/m^2 by drops of .005 mg. size. Ground contamination was 0.07 gms/m^2. No lesions developed.

Non-Casualty

Observer

H 7 The contamination on the observer was 1.18 gms/m^2 by drops of .010 mg. size. Ground contamination was 0.11 gms/m^2. At 24 hours the entire upper back was involved in a faint area of erythema which faded by 72 hours.

Non-Casualty

H 8 The contamination on the observer was 0.09 g/sq. m. The predominant drop size was .015 mg. Ground contamination was 0.03 g/sq. m. At 24 hours there was an area of faint erythema in the middle of the upper part of the back. This had faded by 72 hours.

Non-Casualty

H 9 The contamination on the observer was 0.09 g/sq. m. The predominant drop size was .020 mg. Ground contamination was 0.05 g/sq. m. No lesions developed.

Non-Casualty

J 6 The contamination on the observer was 0.076 gms/m^2 by drops of .01 mg. size. Ground contamination was 0.04 gms/m^2. No lesions developed.

Non-Casualty

J 7 The contamination on the observer was 0.090 gms/m^2 by drops of .01 mg. size. Ground contamination was 0.03 gms/m^2. No lesions developed.

Non-Casualty

J 8 The contamination of the observer was 0.11 gms/m^2 by drops of .015 mg. size. Ground contamination was 0.02 gms/m^2. No lesions developed.

Non-Casualty

J 9 The contamination on the observer was 0.08 gms/m^2 by drops of .01g mg. size. The ground contamination was 0.03 gms/m^2. No lesions developed.

Non-Casualty